

ABSTRACT

A scanning probe detects phase changes of a cantilevered tip proximate to a sample, the oscillations of the cantilevered tip are induced by a lateral bias applied to the sample to quantify the local impedance of the interface normal to the surface of the sample. An ac voltage having a frequency is applied to the sample. The sample is placed at a fixed distance from the cantilevered tip and a phase angle of the cantilevered tip is measured. The position of the cantilevered tip is changed relative to the sample and another phase angle is measured. A phase shift of the deflection of the cantilevered tip is determined based on the phase angles. The impedance of the grain boundary, specifically interface capacitance and resistance, is calculated based on the phase shift and the frequency of the ac voltage. Magnetic properties are measured by applying a dc bias to the tip that cancels electrostatic forces, thereby providing direct measurement of magnetic forces.